

# Chapter 3

## JUNOS Internet Software Overview

The JUNOS Internet software is especially designed for the large production networks typically supported by Internet Service Providers (ISPs). It incorporates Internet Protocol (IP) routing software and software for management of interfaces, networks, and the router chassis.

The JUNOS Internet software runs on the Routing Engine. The software consists of processes that support Internet routing protocols, control the router's interfaces and the router chassis itself, and provide an interface for system management. The processes run on top of a kernel that coordinates the communication among processes and has a direct link to the Packet Forwarding Engine software.

Use the JUNOS Internet software to configure the routing protocols that run on the router and the properties of router interfaces. After you have activated a software configuration, use the JUNOS Internet software to monitor the protocol traffic passing through the router and to troubleshoot protocol and network connectivity problems.



**Note**

The router supports Release 5.2 of the JUNOS Internet software and later versions.

This chapter discusses the following topics:

Routing Engine Software Components on page 38

Tools for Accessing and Configuring the Software on page 42

Software Monitoring Tools on page 42

Software Upgrades on page 42

For complete information about configuring the software, including examples, see the JUNOS Internet software configuration guides.

## Routing Engine Software Components

The Routing Engine software consists of several software processes that control router functions and a kernel that coordinates communication among the processes, as described in the following sections:

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Interface Process on page 41

SNMP and MIB II Processes on page 41

Management Process on page 41

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## Routing Protocol Process

The JUNOS software routing protocol process controls the routing protocols that run on the router. The routing protocol process starts all configured routing protocols and handles all routing messages. It consolidates the routing information learned from all routing protocols into common routing tables. From this routing information, the routing protocol process determines the active routes to network destinations and installs these routes into the Routing Engine's forwarding table. Finally, the routing protocol process implements the routing policies you specify, which determine how routing information is transferred between the routing protocols and the routing table.

This section discusses the following topics:

Routing Protocols on page 38

Routing and Forwarding Tables on page 40

Routing Policy on page 40

For complete information about routing concepts, see the JUNOS Internet software configuration guides.

## Routing Protocols

The JUNOS Internet software implements full IP routing functionality, providing support for IP Version 4 (IPv4) and IP Version 6 (IPv6). The routing protocols are fully interoperable with existing IP routing protocols and provide the scale and control necessary for the Internet core. The software provides support for the following routing and traffic engineering protocols:

Unicast routing protocols

BGP—Border Gateway Protocol, Version 4, is an Exterior Gateway Protocol (EGP) that guarantees loop-free exchange of routing information between routing domains (also called autonomous systems). BGP, in conjunction with JUNOS routing policy, provides a system of administrative checks and balances that can be used to implement peering and transit agreements.

ICMP—Internet Control Message Protocol Router Discovery is a method that hosts can use to discover the addresses of operational routers on a subnet.

IS-IS—Intermediate System-to-Intermediate System is an interior gateway protocol (IGP) for IP networks that uses the shortest-path-first algorithm (SPF algorithm, also called the Dijkstra algorithm) to determine routes.

OSPF—Open Shortest Path First, Version 2, is an IGP developed for IP networks by the Internet Engineering Task Force (IETF). OSPF is a link-state protocol that makes routing decisions based on the SPF algorithm.

RIP—Routing Information Protocol, Version 2, is an IGP for IP networks based on the Bellman-Ford algorithm. RIP is a distance-vector protocol. The JUNOS RIP software is compatible with RIP Version 1.

#### Multicast routing protocols

DVMRP—Distance Vector Multicast Routing Protocol is a dense-mode (flood-and-prune) multicast routing protocol.

IGMP—Internet Group Management Protocol, Versions 1 and 2, is used to manage membership in multicast groups.

MSDP—Multicast Source Discovery Protocol enables multiple PIM sparse mode domains to be joined. A rendezvous point (RP) in a PIM sparse mode domain has a peering relationship with an RP in another domain, thereby discovering multicast sources from other domains.

PIM sparse mode and dense mode—Protocol-Independent Multicast is a multicast routing protocol used to route traffic to multicast groups that might span wide-area and interdomain internetworks. In PIM sparse mode, routers explicitly join and leave multicast groups. PIM dense mode is a flood-and-prune protocol.

SAP/SDP—Session Announcement Protocol and Session Description Protocol handle conference session announcements.

#### Traffic engineering protocols

LDP—Label Distribution Protocol provides a mechanism for distributing labels in non-traffic-engineered applications. LDP allows routers to establish label-switched paths (LSPs) through a network by mapping network-layer routing information directly to data-link layer switched paths. LSPs created by LDP can also traverse LSPs created by Resource Reservation Protocol (RSVP).

MPLS—Multiprotocol Label Switching enables you to configure LSPs through a network either manually or dynamically. You can control how traffic traverses the network by directing it through particular paths, rather than relying on an IGP's least-cost algorithm to choose a path.

RSVP—Resource Reservation Protocol, Version 1, provides a mechanism for engineering network traffic patterns that is independent of the shortest path determined by a routing protocol. RSVP itself is not a routing protocol, but is designed to operate with current and future unicast and multicast routing protocols. JUNOS RSVP software supports dynamic signaling for MPLS paths.

## Routing and Forwarding Tables

The primary function of the JUNOS routing protocol process is maintaining routing tables and using the information in them to determine active routes to network destinations. It copies information about the active routes into the Routing Engine's forwarding table, which the JUNOS kernel copies to the Packet Forwarding Engine.

By default, the routing protocol process maintains the following routing tables and uses the information in each table to determine active routes to network destinations:

**Unicast routing table**—Stores routing information for all unicast protocols running on the router, including BGP, IS-IS, OSPF, and RIP. You can also configure additional routes, such as static routes, for inclusion in the routing table. The unicast routing protocols use the routes in this table when advertising routing information to their neighbors.

In the unicast routing table, the routing protocol process designates routes with the lowest preference values as active. By default, a route's preference value is simply a function of how the routing protocol process learned about the route. You can modify the default preference value by setting routing policies and configuring other software parameters. See "Routing Policy" on page 40.

**Multicast routing table (cache)**—Stores routing information for all multicast protocols running on the router, including DVMRP and PIM. You can configure additional routes for inclusion in the routing table.

In the multicast routing table, the routing protocol process uses traffic flow and other parameters specified by the multicast routing protocol algorithms to select active routes.

**MPLS routing table**—Stores MPLS label information.

You can configure additional routing tables to meet your requirements, as described in the *JUNOS Internet Software Configuration Guide: Routing and Routing Protocols*.

## Routing Policy

By default, all routing protocols place their routes into the routing table. When advertising routes, the routing protocols, by default, advertise only a limited set of routes from the routing table. Specifically, each routing protocol exports only the active routes that were learned by that protocol. In addition, IGPs (IS-IS, OSPF, and RIP) export the direct (interface) routes for the interfaces on which the protocol is explicitly configured.

For each routing table, you can affect the routes that a protocol places into the table and the routes from the table that the protocol advertises by defining one or more routing policies and then applying them to the specific routing protocol.

Routing policies applied when the routing protocol places routes into the routing table are called *import policies* because the routes are being imported into the routing table. Policies applied when the routing protocol is advertising routes that are in the routing table are called *export policies* because the routes are being exported from the routing table. In other words, the terms import and export are used with respect to the routing table.

Routing policy enables you to control (filter) which routes are imported into the routing table and which routes are exported from the routing table. Routing policy also allows you to set the information associated with a route as it is being imported into or exported from the routing table. Routing policies applied to imported routes control the routes used to determine active routes, whereas policies applied to exported routes control which routes a protocol advertises to its neighbors.

You implement routing policy by defining policies. A policy specifies the conditions to use to match a route and the action to perform on the route when a match occurs. For example, when a routing table imports routing information from a routing protocol, a routing policy might modify the route's preference, mark the route with a color to identify it for later manipulation, or prevent the route from even being installed in a routing table. When a routing table exports routes to a routing protocol, a policy might assign metric values, modify the BGP community information, tag the route with additional information, or prevent the route from being exported altogether. You also can define policies for redistributing the routes learned from one protocol into another protocol.

## ***Interface Process***

The JUNOS interface process manages the physical interface devices and logical interfaces on the router. It implements the JUNOS command-line interface (CLI) commands and configuration statements that you use to specify interface properties such as location (FPC location in the FPC card cage and PIC location on an FPC), the interface type (such as SONET/SDH or ATM), encapsulation, and interface-specific properties. You can configure both interfaces that are currently active and interfaces that might be installed later.

The JUNOS interface process communicates with the interface process in the Packet Forwarding Engine through the JUNOS kernel, enabling the JUNOS Internet software to track the status and condition of router interfaces.

## ***SNMP and MIB II Processes***

The JUNOS Internet software supports the Simple Network Management Protocol (SNMP), Versions 1 and 2, which provides a mechanism for monitoring the state of the router. This software is controlled by the JUNOS SNMP and Management Information Base (MIB) II processes, which consist of an SNMP master agent and a MIB II agent.

## ***Management Process***

The management process starts all the other JUNOS software processes and the CLI when the router boots. It monitors the running JUNOS processes and makes all reasonable attempts to restart any process that terminates.

## ***Routing Engine Kernel***

The Routing Engine kernel provides the underlying infrastructure for all JUNOS software processes. It also provides the link between the routing tables maintained by the routing protocol process and the forwarding table maintained by the Routing Engine. Additionally, it coordinates communication with the Packet Forwarding Engine, which primarily involves synchronizing the Packet Forwarding Engine's forwarding table with the master forwarding table maintained by the Routing Engine.

## Tools for Accessing and Configuring the Software

The JUNOS CLI is the primary tool for accessing and controlling the JUNOS Internet software. You use it when accessing the router from the console or through a remote network connection. (For information about connecting a console or other management device to the router, see “Connector Interface Panel (CIP)” on page 27.) The CLI includes commands for configuring router hardware, the JUNOS Internet software, and network connectivity.

The JUNOS CLI is a straightforward command interface. You type commands on a single line and enter the commands by pressing the Enter key. The CLI provides command help and command completion, as well as Emacs-style keyboard sequences for moving around on a command line and scrolling through a buffer that contains recently executed commands. For more information about the CLI, see the *JUNOS Internet Software Configuration Guide: Getting Started*.

## Software Monitoring Tools

In addition to commands for configuring router hardware and software, the CLI includes commands for monitoring and troubleshooting hardware, software, routing protocols, and network connectivity. CLI commands display information from routing tables, information specific to routing protocols, and information about network connectivity derived from the ping and traceroute utilities.

You can also use the JUNOS Internet software implementation of SNMP to monitor routers. The SNMP software consists of an SNMP master agent and a MIB II agent. It provides full support for MIB II SNMP Version 1 traps and Version 2 notifications, SNMP Version 1 Get and GetNext requests, and Version 2 GetBulk requests. For more information about SNMP, see the *JUNOS Internet Software Configuration Guide: Network Management*.

The software also supports tracing and logging operations, which you can use to track normal router operations, error conditions, and the packets that the router generates or forwards. Logging operations use a syslog-like mechanism to record systemwide, high-level events such as interfaces going up or down and user logins on the router. Tracing operations record more detailed information about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions.

## Software Upgrades

The router is delivered with the JUNOS Internet software preinstalled. To upgrade the software, you use CLI commands to copy a set of software images over the network to the router's flash disk. The JUNOS Internet software set consists of several images provided in individual packages or as a bundle. You normally upgrade all packages simultaneously. For information about installing and upgrading JUNOS software, see the *JUNOS Internet Software Configuration Guide: Getting Started*.